KNOWLEDGE REPRESENTATION AND REASONING

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Abstract

This paper provides a professional approach to construct a Knowledge Representation and Reasoning module. Development of AGI agents require architecture modeled after human cognition and this also provides framework for agents that have interaction with actual world and to constitute and use it for making decisions that capture and permit implementation of behaviour.

1. Background

From an Artificial Intelligence point-of-view, we are able to model an agent for receiving input from its surroundings and giving output to it, just like humans. We recognize that an agent which has desires and searches for answers to the desires can do better than one that just reacts to its surroundings. There exist different types of artificial smart agents that deal with the actual world but they are application-specific. A knowledge based agent desires to have large facts, the current state of the arena; what it desires to achieve; and what its own actions do in various circumstances. Knowledge-based agents are capable of accepting new responsibilities in the form of explicitly described desires; they can achieve competence quickly by being told or learning new information about the surroundings; and they could adapt to modifications in the surroundings by updating the applicable information. To layout such agents that cope with the actual global human surroundings, we want to take a biologically-inspired technique and version the agent's facts processing device primarily based totally on human cognition.

2. Introduction

When we say that people know things, we mean that there is information that has been compromised with their memory and is presented in a certain way that we call knowledge. When we say "what people know helps them do things" means with these representations of knowledge they are able to argue and take actions**.** In order to design such an agent, it is therefore important that we first model it as a knowledge-based agent that can learn and argue. Knowledge representation refers to general methods of describing states and actions within agents. We first explain in detail what knowledge representation means, followed by creating a basic design for a knowledge base. The information processing unit of an AGI agent consists of a knowledge base. In order to create a KB and initially fill it, we first define an ontological engineering of these concepts that leads to the corresponding data management. The structure of the knowledge base and the language that make up the representational aspects of the KB are discussed**.** A logical language is developed that this agent uses to express knowledge and make decisions about the world and taking their own actions**.** It is subjected to a data pre-initialization before implementation, which can be classified as agent's prior knowledge. It is used to model a significant piece of knowledge about the real world including time, beliefs, changes, physical objects among others that will eventually automate your learning process.

3.Knowledge Representation

A subfield of AI, Knowledge Representation is about representing information in a form that an AI agent can utilize to solve complicated tasks. A knowledge base agent has a central component Knowledge Base(KB).The axioms in KB are in detail inside a database and are expressed in Knowledge Representation language. We can outline automated techniques to upload new sentences to the KB for decision-making and reasoning. From a simple model of an agent with a skeleton knowledge set, we goal to attain a complicated database of knowledge. Logical reasoning is used to maintain a description of the arena, the new percepts that arrive and to deduce a course of action to attain its goals. We will extend the talents of our agent through incorporating a capability for widespread logical reasoning. The language of classical logic that is extensively used in the idea of knowledge representation is first-order logic formulas. One of the critical subsets of first-order logic is propositional logic. But propositional logic is too easy to version complicated environments. Consequently we are able to put into effect first-order logic which is adequately expressive to seize a good deal of complicated understanding. While programming languages require a procedural approach to allow them to derive information from existing information, we are able to use a declarative one for reasoning. These sentences are shaped in keeping with the syntax of the Representation language. While the syntax defines the structure of the sentence, the semantics outline what that means. Furthermore, the connection of entailment among sentences is essential for reasoning. A sentence X entails some other sentence Y if Y is true in the context , in which X is true. While growing a logic language, we have to additionally consider user-friendliness. While natural languages permit us to concisely represent information, logical languages want to be constructed extra expressively. To do this, we increase our language in a modular manner, combining both formal and natural languages. Within our logical language, we define objects which constitute nouns and noun terms and members of the family amongst some of those members of the family are functions where there is a one-on-one mapping and best one "value" for a given "input." An extra characteristic that have to be referred here is set the ontological and epistemological

commitments that characterizes our logical language. In phrases of ontology, those are expressed inside Mathematics, in the shape of formal models, which preserve the fact value of sentences that are defined. Note that sentences and factors had been interchangeably used. First-order logic assumes a model to be in the state of true/false, and additionally, what members of the family preserve amongst the objects in the world. In phrases of epistemology, an axiom can represent a fact that an agent both accepts as true, false, or does now no longer have an opinion on it. The essential issue is that maximum generalizations have exceptions or preserve best to a diploma.

3.1 First Order Logic

In the formalizing of a language, for usage of logical reasoning, we first define a domain for it. The domain of a model is a set of all the domain factors in which the model represents the arena and the factors constitute the objects in that world.

Syntax

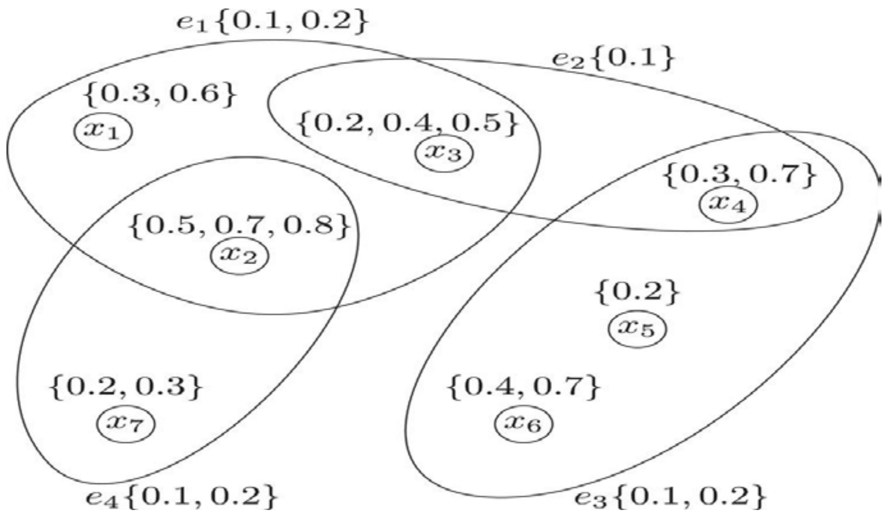
In first-order logic, a signature is a set of symbols: function constants and predicate constants—with a non negative integer known as the arity, assigned to each symbol. Function constants of arity zero are known as object constants; predicate constants of arity zero are known as propositional constants. A term is a logical expression that refers to an object. The grammar cited above is sufficient for us to form an atomic sentence. We can outline the forms of sentences as: Sentence → Atomic Sentence | Complex Sentence Atomic Sentence → Predicate | Predicate (Term, . . .) | Term = Term Complex Sentence → (Sentence) | [Sentence](with connectives..) Using logical connectives and the quantifiers ∀, ∃ we also can form complicated sentences. Terms which have confer with objects' values in an absolute way are known as variables and lastly, a time period and not using a variables is known as a floor time period.

Semantics

The semantics of first-order logic defines, for any sentence F and any interpretation I of a signature σ, the fact price FI this is assigned to F via way of means of I. This first order language has variables for humans, which includes Ahmad and Isa, however now no longer for locations, which includes their study room. In this sense, humans are "reified" on this language, and locations are now no longer. To reify locations, we can upload them to the signature as a 2nd sort, upload study room as an extra item steady of that sort, and flip in right into a binary predicate steady with the argument types individual and place. In the changed language, the method in(Ahmad) will grow to be in(Ahmad, study room) which makes the language extra expressive. The syntax and semantics of the proposed logical language have been developed correctly sufficient for us to start the construction of a knowledge base. It must be referred to that the improvement system ensues, and with progress, we are able to face extra complicated records approximately the actual global to be able to require vast modeling and introducing new concepts.

3.2 Hyper graph

A hyper graph permits us to express higher-order information. Hyper graphs generalize the common perception of graphs by relaxing the definition of edges. An edge in a graph is truly a couple of vertices while a hyper edge in a hyper graph is a set of vertices. Also vice-versa, a hyper graph can comprise nodes a number of which could hyper edges. The structure of a hyper graph permits for the benefit of building high-order relationships. A hyper graph structure is adaptable, to construct relations of contextual information and serial information. Thus, adding another dimensionality to our model, we shape a "weighted, labeled hyper graph" whose edges and vertices come along side labels, in addition to numbers that we call "weights". The label associated with an edge may be interpreted as defining the "type" of entity its while, a weight that can be connected to an vertex is a probability, representing how crucial the vertex is to the system.



3.3 Knowledge Engineering

Data usually requires an assortment of a type, for it make sense. Since our hyper network database is going to be appreciably large and intricate, we need to sort it appropriately. In Information Sciences, large-scale knowledge representations require a general reason ontology to arrange collectively the numerous particular domains of knowledge. A general-purpose ontology needs to cover a wide variety of knowledge and have to be capable, in principle, of coping with any domain. We will use popular ontological engineering for knowledge representation as compared to special-reason knowledge engineering that's domain-specific. Upper ontology is based on classes and the event calculus. It can span classes, subcategories, parts, structured objects, measurements, substances, events, time and space, change, and beliefs to support a broad semantic interoperability cross-domain. The organization of objects into classes is a crucial a part of knowledge representation. A subcategory permits multi-degree classification. Categories serve to arrange and simplify the knowledge base through inheritance. Subcategory relations prepare classes into a taxonomy. Overall, those ideas permit us to preserve structural integrity of the information base and assist in the emergent decision-making.

4. Reasoning

With the database defined, we take into account the useful components of KR. Based on its reminiscence, the agent has to make complicated choices however reasoning itself is a huge field. These techniques encompass mathematical and programming approaches. The logic language we have developed, defines the components of the arena as capabilities which form a feature set. Because we will version a hyper graph as a set system we will carry out logical operations on it. Each feature set is modeled by a hyper graph in which the complicated relations may be represented by hyper edges. A match among the feature sets is then modeled as a hyper graph matching problem. Logic allows us to reason from functions such as Induction, Deduction, Abduction. We aim to increase and include all of those functionalities inside our system. In addition, there additionally exist plenty of artificial neural networks that execute those obligations modularly. Although neural networks may play a role in the KR of our agent, they'll now no longer be used ordinarily for reasoning. In logical reasoning, we have an advantage in our version being primarily based totally on predicate calculus: its usability of mathematical tools. Morphism refers to a structure-retaining map from one mathematical structure to another. For reasoning inside hyper graphs: - inference may be made via way of means of graph mono morphism in which a morphism $f: X \to Y$ is referred to as a mono morphism if $f \circ g1 = f \circ g2$ implies $g1 = g2$; - matching may be made by isomorphism in which a morphism $f: X \to Y$ is referred to as an isomorphism if there exists a morphism $g: Y \to X$ such that $f \circ g = idY$ and $g \circ f = idX$.

5.Conclusion

Knowledge illustration is going hand in hand with computerized reasoning due to the fact one of the essential functions of explicitly representing know-how is on the way to purpose approximately that know-how, to make inferences, assert new know-how, etc. Virtually all know-how illustration languages have a reasoning or inference engine as a part of the system.

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